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Structure of the Mangrove Community in the Pangkalan Jambi Village, Bukit Batu District, Bengkalis

Struktur Komunitas Mangrove di Desa Pangkalan Jambi, Kecamatan Bukit Batu, Kabupaten Bengkalis

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Abstract

Mangroves are coastal ecosystems that play a very important ecological and economic role. This study aims to analyze mangrove species, density, and importance index. The method used was a survey method with the determination of research stations using purposive sampling, where the research location was divided into 3 stations based on criteria, namely station 1 mangrove forest located in Damai Village with relatively good mangrove conditions, station 2 mangrove forest located in Rukun Village which is a mangrove ecotourism area, and Station 3, a mangrove forest located in Murni Village, which is adjacent to a residential area. The results of water quality parameter measurements in Pangkalan Jambi Village showed salinity values of 19-22, pH values of 5.4-6.5, and temperatures of 29-30 ℃. Based on the study, five mangrove species were found in the mangrove forest area of Pangkalan Jambi Village: *Rhizophora apiculata, Xylocarpus granatum, Nypa fruticans*, *Avicennia marina*, and *Taliparitì. tiliaceum*. The density in the tree category at station I had the highest density, 1566.66 ind/ha, while the lowest was at station II, 300 ind/ha. In the seedling category, the highest density was found at station I with a density value of 4800 ind/ha, while the lowest density was found at station II with a density value of 3466.67 ind/ha. In the seedling category, the highest density was found at station I with a density value of 7500 ind/ha, while the lowest density was found at station II with a density value of 5000 ind/ha. Based on the average Importance Value Index calculation, the highest INP value was R. apiculata at 249.295%, and the lowest was S. alba at 178.588%.

Keywords: Structure, Mangrove, Density, Pangkalan Jambi, Bengkalis

Abstrak

Mangrove adalah ekosistem pesisir yang memiliki peran ekologi dan ekonomi yang sangat penting. Penelitian ini bertujuan untuk menganalisis spesies mangrove, kepadatan, dan indeks nilai pentingnya. Metode yang digunakan adalah metode survei dengan penentuan stasiun penelitian menggunakan *sampling purposif*, di mana lokasi penelitian dibagi menjadi 3 stasiun berdasarkan kriteria, yaitu stasiun 1 hutan mangrove yang terletak di Desa Damai dengan kondisi mangrove yang relatif baik, stasiun 2 hutan mangrove yang terletak di Desa Rukun yang merupakan kawasan ekowisata mangrove, dan stasiun 3 hutan mangrove yang terletak di Desa Murni yang berdekatan dengan kawasan permukiman. Hasil pengukuran parameter kualitas air di Desa Pangkalan Jambi menunjukkan nilai salinitas berkisar 19-22, pH berkisar 5,4-6,5, dan suhu antara 29-30 ℃. Berdasarkan hasil penelitian, ditemukan 5 spesies mangrove di kawasan hutan mangrove Desa Pangkalan Jambi, yaitu spesies *Rhizophora Apiculata*, *Xylocarpus granatum*, *Nypa Fruticans*, *Avicenia Marina*, dan *Taliparitì*.

Tiliaceum. Kepadatan pada kategori pohon di stasiun I memiliki kepadatan tertinggi dengan nilai kepadatan 1566,66 ind/ha, sedangkan nilai kepadatan terendah terdapat di stasiun II dengan nilai kepadatan 300 ind/ha. Pada kategori bibit, kepadatan tertinggi terdapat di stasiun I dengan nilai kepadatan 4800 ind/ha, sedangkan kepadatan terendah terdapat di stasiun II dengan nilai kepadatan 3466,67 ind/ha. Pada kategori bibit, kepadatan tertinggi terdapat di stasiun I dengan nilai kepadatan 7500 ind/ha, sedangkan kepadatan terendah terdapat di stasiun II dengan nilai kepadatan 5000 ind/ha. Berdasarkan perhitungan Indeks Nilai Penting rata-rata, diketahui bahwa nilai INP tertinggi adalah *R. apiculata* dengan persentase 249,295% dan nilai INP terendah adalah *S. alba* 178,588%.

Kata kunci: Struktur, Mangrove, kepadatan, Pangkalan Jambi, Bengkalis

1. Introduction

Mangroves are coastal ecosystems that play a vital ecological and economic role. Ecologically, mangrove forests protect the coast from abrasion/erosion, stabilize shorelines, and provide habitat for various biota (e.g., birds, fish, shrimp, molluscs) (Purwanto, 2020). Mangrove ecosystems act as carbon sinks and climate buffers, making them strategically valuable to the coastal environment and the welfare of residents (Badrun, 2015). Economically, coastal communities depend on this ecosystem for their livelihoods through the use of wood products, leaves for medicine, building materials, and ecotourism potential (Purwanto, 2020).

The rate of mangrove deforestation in Indonesia remains high, driven by, among other things, illegal logging and the excessive use of mangrove wood for construction materials, firewood, and industrial purposes. One area rich in mangrove natural resources is Pangkalan Jambi Village, located in Bukit Batu District, Bengkalis Regency. The eastern area of Pangkalan Jambi Village is a coastline directly adjacent to the Bengkalis Strait, which is prone to abrasion. The limited presence of mangroves and coastal hydrodynamic phenomena, such as waves, currents, and tides, are driving factors of abrasion. Technically, abrasion conditions are not only influenced by hydro-oceanographic processes. However, natural factors on land can change the coastline, such as sedimentation and erosion from river tides (floods) and changes in river flow.

Research on the structure of mangrove communities in Bengkalis indicates that this area has high biodiversity and is important to protect. According to Purwanto (2020), the coastal land in Pangkalan Jambi Village has retreated by 115 m, or approximately 5 meters per year, over the past 20 years. This decline in mangrove vegetation is caused by land conversion, such as land clearing for tourism facilities and infrastructure, road construction, housing, and school construction, all of which are squeezing mangrove forest areas that local communities have used for medicine, food, and other needs such as firewood, building materials, and boats (Alvareza & Leilani, 2020).

Many studies have been conducted on mangrove community structure, especially in Riau Province. Mulyani et al. (2024) studied mangrove community structure in Bukit Batu District, Hasyim et al. (2022) studied mangrove community structure in Dumai, Mulyani et al. (2024) studied multivariate and mangrove community structure in North Rupat, Badrun (2015) studied mangrove community structure in Sesa Teluk Lecah, Bengkalis Regency, and Badrun (2015) studied mangrove community structure in Indragiri Hilir, Riau.

Various biotic and abiotic factors, including soil type, salinity, and tidal conditions, influence mangrove density. The mangrove species that dominates growth in the research area is *Rhizophora apiculata*. This mangrove species also has the highest density and importance value index among the species. In connection with the above problems, the types of mangroves, mangrove densities, the number of Important Value Indexes (INP), and the distribution of zoning patterns for the mangrove community structure in Pangkalan Jambi Village have not been identified. Therefore, to provide clear information regarding the variables included in the community structure above, this research was conducted as an additional reference.

2. Material and Method

2.1. Time and Place

This research was conducted in February 2025 in Pangkalan Jambi Village, Bukit Batu District, Bengkalis Regency. Sample analysis was conducted at the Marine Biology Laboratory, Department of Marine Sciences, Faculty of Fisheries and Marine Sciences, Universitas Riau.

2.2. Methods

The research method is a survey: observing each mangrove tree within a quadrant and recording its type and number. This method is used to determine the number of species in a given area unit or the number of individuals

of a given species in that area unit. Data consist of measurements made in the field or in the laboratory. Data in the form of data obtained from local agencies in Pangkalan Jambi Village, Bukit Batu District, Bengkalis Regency, in the form of tidal data and regional topography.

2.3. Procedures

2.3.1. Establishment of Research Station

The research stations were determined based on the results of a field survey that accounted for the characteristics of coastal waters, including differences in conditions at the research locations. Sampling was conducted at three stations: Damai Hamlet, Pangkalan Jambi Village (Station 1); Rukun Hamlet, Pangkalan Jambi Village (Station 2); and Murni Hamlet, Pangkalan Jambi Village (Station 3). Each station had three transects, and each transect had three plots.

3. Result and Discussion

3.1. Water Quality

The results of water quality measurements of physical and chemical parameters at the research location show salinity values ranging from 19-22 ‰, pH values ranging from 5.4-5.6, and temperatures ranging from 29-30ºC, as shown in Table 1.

Table 1. Average water quality parameters in Pangkalan Jambi Village

Station	Parameter		
	pH	Temperature (ºC)	Salinity (‰)
I	5.6	29	19
II	6.5	26	21
II	5.4	30	22
Average	5.83	28.33	20.66

The results of water-quality measurements of physical and chemical parameters at the research location showed an average salinity of 20.33 ‰, a pH of 2.43, and a temperature of 29.66 ºC. Mangrove plants grow optimally in the salinity range of 19-22 ppt, and most plants can survive at a salinity level of 35 ppt. pH Waters with a pH of 5.3-5.6 are considered productive, and waters with a pH of 7.5-8.5 are considered very productive. Seawater temperatures in mangrove forests range from 29.0°C-30ºC at low tide and between 29.5°C-30.0°C at high tide.

3.2. Types of Mangrove Vegetation

There are several types of mangrove vegetation found in Pangkalan Jambi Village, as listed in Table 2. The types of mangrove vegetation observed at each observation station are shown in Table 3.

Table 1Types of Mangrove Vegetation Found in Pangkalan Jambi Village

No	Family	Code	Scientific Name	Local Name
1	*Rhizophoraceae*	Ra	*Rhizophora apiculata*	Oil Mangrove
2	*Meliaceae*	Xg	*Xylocarpus granatum*	Chewing betel, chewing betel
3	*Avicenniaceae*	Am	*Avicennia marina*	White Flames
4	*Arecaceae*	Nf	*Nypa frutican*	Nipah
5	*Malvaceae*	Tt	*Taliparitiliaceum*	Cotton

Table 3. Distribution of mangrove species found in Pangkalan Jambi Village

Station	*Ra*	*Am*	*Xg*	*Nf*	*Tt*
I	+	+	+	-	+
II	+	+	+	+	+
III	+	+	+	-	+

Note: (+) = Found (-) = Not found

Based on the research results, five mangrove species were found in the Pangkalan Jambi area, Bukit Batu District, Bengkalis Regency, namely *Rhizophora apiculata, Avicennia marina, Xylocarpus granatum, Nypa fruticans,* and *Thespesia tiliaceum*. These mangroves of *the family Rhizophoraceae* dominate because they adapt well to estuaries with muddy substrates. Its strong root system binds mud particles, thus supporting the growth of mangrove vegetation. These results align with research by Hasyim et al. (2022) in Sungai Sembilan, Dumai City, which found similar species, albeit in slightly different numbers. This illustrates that mangrove species composition can vary depending on local environmental conditions. The ANOVA test results showed p-values of 0.2977 (tree category), 0.7761 (saplings), and 0.9098 (seedlings), respectively. A *p-value*> 0.05 for all categories indicated no significant differences between observation stations. Thus, the structure and composition of mangroves at each station were relatively uniform. The mangrove community structure in the tree category at the

research location varied across stations. The types of mangroves found in each plot are shown in Table 2, and the average density and importance value index are shown in Table 4.

Table 2Mangrove community structure for tree categories at stations I, II, and III

ST	Spesies	Jlh	BA (cm^2)	K (ind/ha)	Kr (%)	D (m^2/ha)	Dr (%)	F	Fr (%)	INP (%)
I	*A. marina*	6	359,32	200	12,77	0,23	22,72	0,67	22,22	57,71
	R.apiculata	31	1031,80	1033,33	65,95	0,65	65,25	1,00	33,34	164,54
	T.tilacium	6	25,80	200	12,77	0,02	1,63	0,67	22,22	36,62
	X.granatum	4	164,33	133,33	8,51	0,1	10,40	0,67	22,22	41,13
	Jumlah	47	1581,21	1566,66	100,00	1,00	100,00	3,00	100,00	300,00
II	*R.apiculata*	4	432,16	133,33	44,45	0,67	67,47	0,33	20,00	131,92
	A. marina	2	11,53	66,68	22,22	0,02	1,80	0,33	20,00	44,02
	T.tilacium	1	97,44	33,33	11,11	0,15	15,21	0,33	20,00	46,32
	X.granatum	1	49,72	33,33	11,11	0,08	7,76	0,33	20,00	38,87
	N.frutican	1	49,72	33,33	11,11	0,08	7,76	0,33	20,00	38,87
	Jumlah	9	640,57	300	100,00	1,00	100,00	1,65	100,00	300,00
III	*A.marina*	5	66,81	166,67	20,83	0,06	5,67	0,33	14,29	40,78
	R.apiculata	9	573,98	300	37,51	0,49	48,65	1,00	42,85	129,01
	T.tilacium	5	474,90	166,67	20,83	0,40	40,25	0,33	14,29	75,38
	X.granatum	5	64,03	166,67	20,83	0,05	5,43	0,67	28,57	54,83
	Jumlah	24	1179,71	800	100,00	1,00	100,00	2,33	100,00	300,00

Information: K : Density; KR: Relative Density; F : Frequency; FR : Relative Frequency; BA: Basal Area; D: Dominance; DR: Relative Dominance; NP : Importance Value Type; Ra : *Rhizophora apiculata;* Am: *Avicennia marina;* Xg: *Xylocarpus granatum;* Tt : *Taliparitі tiliaceum;* Nf: *Nypa fruticans*

Table 5. Average Value of Tree Category Density

No	Type	Density (ind/ha)			Average K (ind/ha)
		St. I	St. II	St. III	
1.	*R. apiculata*	1,033.33	133.33	300	1,266.66
2.	*X. grenatum*	133.33	33.33	166.67	111.09
3.	*A. marina*	200	66.68	166.67	144.44
4.	*T. tiliaceum*	200	33.33	166.67	133.33
5.	*N. frutican*	-	33.33	-	11.11
	Total	1,566.66	300	800.01	1,666.66

Table 6. Average Value of the Importance Value Index of Tree Categories

No	Type	Importance Value Index (%)			Average INP (%)
		St. I	St. II	St. III	
1.	*R. apiculata*	164.54	131.92	129.01	141.82
2.	*X. granatum*	41.13	38.87	54.83	41.94
3.	*A. Marina*	57.71	44.02	40.78	47.50
4.	*T. tiliaceum*	36.62	46.32	75.38	52.77
5.	*N. frutican*	-	38.87	-	12.95
	Total	300	300	300	296.98

Table 3Mangrove Community Structure for Sub-Species Categories at Stations I, II and III

ST	Type	total	K (ind/ha)	KR (%)	F	FR (%)	BA (cm^2)	D (m^2/ha)	DR	INP (%)
I	*A. Marina*	15	2000	41.67	0.67	33.50	168.82	0.37	37.00	112.17
	R. apiculata	17	2266.67	47.22	0.10	50.00	177.92	0.38	38.00	135.22
	X.granatum	4	533.33	11.11	0.33	16.50	120.87	0.25	25.00	52.61
	Amount	36	4800	100.00	2.00	100.00	467.61	1.00	100.00	300.00
II	*R. apiculata*	10	1333.33	38.46	1.00	42.74	96.54	0.45	45.24	122.60
	X.granatum	7	1200	34.62	0.67	28.63	68.65	0.32	32.18	99.27
	A. Marina	5	933.33	26.92	0.67	28.63	48.18	0.23	22.58	78.13
	Amount	28	3466.67	100.00	2.34	100.00	213.37	1.00	100.00	300.00
III	*R. apiculata*	11	1466.67	39.29	1.00	42.86	56.76	0.45	43.59	125.74
	A. Marina	8	1066.67	28.57	0.33	14.28	37.12	0.28	28.51	71.36
	X.granatum	9	1200	32.14	1.00	42.86	36.32	0.27	27.90	102.90
	Amount	28	3733.33	100.00	2.33	100.00	130.20	1.00	100.00	300.00

Table 8. Average Value of the Density of Offspring Categories

No	Type	Density (ind/ha)			Average K (ind/ha)
		St. I	St. II	St. III	
1.	*R. apiculata*	2,266.67	1333.33	1,466.67	1644.44
2.	*X. granatum*	533.33	1200	1200	1022.22
3.	*A. marina*	2,000	933.33	1,066.67	1333.33
4.	*T. tiliaceum*	-	-	-	-
5.	*N. frutican*	-	-	-	-
	Total	4800	3466.66	3733.34	3999.99

Table 9. Average Value of the Density of Offspring Categories

No	Type	Importance Value Index (%)			Average INP (%)
		St. I	St. II	St. III	
1.	*R. apiculata*	135.22	122.60	125.74	141.82
2.	*X. granatum*	52.61	99.27	71.36	41.94
3.	*A. Marina*	112.17	78.13	102.90	47.50
4.	*T. tiliaceum*	-	-	-	-
5.	*N. frutican*	-	-	-	-
	Total	300	300	300	231.26

Table 10. Mangrove Community Structure in the Seedling Category

Station	Type	Amount	K (ind/ha)	KR (%)	F	FR (%)	INP (%)
I	*X.granatum*	1	833.33	11.11	0.33	16.50	27.61
	R. apiculata	6	5000	66.67	1.00	50.00	116.67
	A. Marina	2	1666.67	22.22	0.67	33.50	55.72
	Amount	9	7500	100.00	2.00	100.00	200.00
II	*A. Marina*	1	833.33	16.67	0.33	33.33	50.00
	R. apiculata	5	4166.67	83.33	0.67	66.67	150.00
	Amount	6	5000	100.00	1.00	100.00	200.00
III	*A. Arina*	3	2500	42.86	0.67	50	92.86
	R. apiculata	4	3333.33	57.14	067	50	107.14
	Amount	7	2833.33	100.00	1.34	100.00	200.00

Table 11. Average Density of Seedling Categories

No	Type	Density (ind/ha)			Average K (ind/ha)
		St. I	St. II	St. III	
1.	*R. apiculata*	5000	4166.67	333.33	3166.66
2.	*X. granatum*	833.33	-	-	277.77
3.	*A. Marina*	1666.67	833.33	2500	1666.66
4.	*T. tiliaceum*	-	-	-	-
5.	*N. frutican*	-	-	-	-
	Total	7500	5000	2833.33	5111.09

Table 12. Average Importance Value Index of the Seedling Category

No	Type	Importance Value Index (%)			Average INP (%)
		St. I	St. II	St. III	
1.	*R. apiculata*	116.67	150.00	107.14	124.60
2.	*X. granatum*	27.61	-	-	9.20
3.	*A. Marina*	55.72	50.00	92.86	66.19
4.	*Taliparitiliaceum*	-	-	-	-
5.	*N. frutican*	-	-	-	-
	Total	200	200	200	199.99

The analysis results show that the highest mangrove density in Pangkalan Jambi Village is found at Station I for all growth stages, namely trees (1,566.66 ind/ha), seedlings (4,800 ind/ha), and saplings (7,500 ind/ha). Station II has the lowest density, while Station III is in the middle position. The high density at Station I is likely due to the area being a well-maintained village forest and having supportive environmental conditions, such as mud substrate suitable for mangrove growth. *Rhizophora apiculata* has good adaptability to various types of substrates. Overall, mangrove density in Pangkalan Jambi Village, particularly at Station I, is considered good and stable, reflecting the effectiveness of conservation efforts for the mangrove ecosystem. However, monitoring human activity remains necessary to maintain the area's sustainability.

The results showed that *Rhizophora apiculata* had the highest Importance Value Index (IVI) at all growth stages across all observation stations in Pangkalan Jambi Village. This indicates that the species plays a dominant role in the local mangrove community structure. The high IVI value reflects *Rhizophora apiculata's* adaptability, competitiveness, and efficient use of environmental resources. This dominance indicates that environmental

conditions at the research site strongly support the growth of this species, particularly in terms of substrate, salinity, and habitat stability. Therefore, *Rhizophora apiculata* is a key indicator of mangrove ecosystem stability in Pangkalan Jambi Village, and its sustainability needs to be maintained through continuous management and monitoring.

4. Conclusions

Based on the study, 5 species were found at the research location: *Rhizophora apiculata, Avicennia marina, Xylocarpus granatum, Nypa fruticans, and Taliparititi tiliaceum*. The dominant species in the tree category at stations I, II, and III is *Rhizophora apiculata*. *Rhizophora apiculata* dominates the sapling category *at stations I, II, and III*. The seedling category at stations I, II, and III is *Rhizophora apiculata, and the Rhizophora apiculata type* is the most dominant species, with the highest importance value index among the tree categories at I, II, and III. The sapling category has the highest importance value index at stations I, II, and III, namely *Rhizophora apiculata*. The seedling category has the highest importance value index, followed by *Rhizophora apiculata*.

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